

REMARKS

Claims 1-18 are now present in this application.

The specification and claims 1-7 have been amended. Reconsideration of the application, as amended, is respectfully requested.

A Restriction Requirement has been given between the following groups:

Group I, claims 1-7; and

Group II, claims 8-18.

In response to this Restriction Requirement, Applicants have elected Group I, claims 1-7, in a telephone conversation with the Examiner. This election was with traverse.

It is respectfully submitted that it should be no undue burden on the Examiner to consider all claims in this single application. Nonetheless, if the Examiner is to persist in this requirement, Applicants reserve the right to file a Divisional application at a later time, if so desired.

The disclosure stands objected to and claims 2-7 stand objected to for certain informalities. Because these informalities have now been addressed, it is respectfully requested that the objection to the specification and claims now be reconsidered and withdrawn.

Claims 3 and 4 stand rejected under 35 USC 112, first paragraph. This rejection is respectfully traversed.

The Examiner alleges that the specification does not enable one skilled in the art to make and/or use the invention. It is alleged that the bearing housing being pre-pressurized is not clear. Applicants respectfully disagree with this position. As shown in Fig. 5F, for example, pre-pressure 60 is being applied. This arrangement is also discussed on page 6, lines 19-24 of the specification, for example. It is respectfully submitted that, with the teachings in hand, one skilled in the art could produce a hydrodynamic and hydrostatic hybrid bearing which would be pre-pressurized. Such pre-pressurization is indicated in Figs. 1 and 3 of the present application. It should be apparent that, within the housing 20, the sealing unit 70 forms a space. Lubricant blocks the exit from the space such that pressurization can be held therein. It should be apparent to those skilled in the art how to pressurize such a space. It is respectfully submitted that the present application does enable one skilled in the art to make and/or use the invention. It is therefore respectfully requested that the 35 USC 112, first paragraph rejection now be reconsidered and withdrawn.

Claims 1, 3-4 and 6-7 stand rejected under 35 USC 102(b) as being anticipated by LEE et al., U.S. Patent 6,071,014. This rejection is respectfully traversed.

Claims 2 and 5 stand rejected under 35 USC 103 as being unpatentable over LEE et al., and further in view of MORI et al., U.S. Patent 6,023,114. This rejection is respectfully traversed.

The patent to LEE et al. discloses a spindle motor with hybrid air/oil hydrodynamic bearing. Fig. 9 of this patent has been noted by the Examiner. Various embodiments are shown throughout the patent, with Fig. 9 being a fifth embodiment. In this embodiment, lubricant, such as oil or grease, is filled between the stationary sleeve 166e, the thrust plate 142e, and the containment plate 154e, as discussed in column 7, lines 25-27. There is a certain pattern of grooves which is formed in order to pressurize the lubricant. In the embodiment of Fig. 3, grease or oil 158a is also utilized. This arrangement is discussed in the sentence bridging columns 4 and 5. In column 5, lines 9-13, it is discussed how a pattern of grooves can be provided in order to pump the oil readily outward to the shaft. Fig. 4 shows a herringbone pattern 162a. It should be noted, however, that the oil or grease is not allowed to flow through the thrust plate 142a.

The Examiner has additionally noted herringbone grooves 170a, 172a, which are apparently shown in Fig. 5. These grooves, however, are not formed for grease or oil, but for pumping air upwardly or downwardly (note column 5, lines 40-53). Moreover, these grooves are in the hub sleeve 162a, which, as shown in Fig. 3, is located far from the central shaft as well as the lubricant or grease 158a.

Nonetheless, in the LEE et al. patent, the claimed hydrodynamic and hydrostatic hybrid bearing of the present invention is not shown. As set forth in claim 1, there is a bushing in this bearing which has a plurality of dynamic pressure generating grooves, which are penetrated through the bushing. As disclosed in the specification, this will allow the stored lubricant to pass therethrough. There are no grooves in either the thrust plate 142 or distantly located hub sleeve 162a in the Fig. 3-5 embodiment, or in the arrangement of Fig. 9 of LEE et al. Any grooves formed in the LEE et al. arrangement do not penetrate through the bushing.

A secondary reference to MORI et al. has merely been relied upon for showing a porous material for storing lubricant. The teachings of MORI et al. do not overcome the deficiencies of the LEE et al. reference. It is respectfully submitted that the prior art utilized by the Examiner would neither suggest nor render obvious the hydrodynamic and hydrostatic hybrid bearing, as recited in independent claim 1 and dependent claims 2-7 of the present application. The grooves in the LEE et al. arrangement are merely formed on an outer surface and do not penetrate through the hub sleeve or thrust plate. Additionally, it is noted that this is a liquid hydrodynamic bearing and an aerodynamic bearing.

With the design of the present invention, assembly of the hydrodynamic and hydrostatic hybrid bearing is more easily carried

out. It is respectfully submitted that the prior art utilized by the Examiner would neither suggest nor render obvious the claims of the present application. Accordingly, it is respectfully requested that the 35 USC 102(b) and 103 rejections now be reconsidered and withdrawn.

Favorable reconsideration and an early Notice of Allowance are earnestly solicited.

Because the additional prior art cited by the Examiner has been included merely to show the state of the prior art and has not been utilized to reject the claims, no further comments concerning these documents are considered necessary at this time.

In the event that any outstanding matters remain in this application, the Examiner is invited to contact the undersigned at (703) 205-8000 in the Washington, D.C. area.

Attached hereto is a marked-up version of the changes made to the application by this Amendment.

Pursuant to 37 C.F.R. §§ 1.17 and 1.136(a), the Applicants respectfully petition for a one (1) month extension of time for filing a response in connection with the present application and the required fee of \$110.00 is attached herewith.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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Attachment: Version with Markings to Show Changes Made

VERSION WITH MARKINGS TO SHOW CHANGES MADEIN THE SPECIFICATION:

The paragraph beginning on page 1, line 18, has been amended as follows:

--Generally speaking, there are two types of bearings: the hydrostatic bearing and hydrodynamic bearing. The hydrostatic bearing is normally a bearing with a hydro lubricant. When the motor rotates, it utilizes hydro pressure to support its shaft. If its shaft deviates, pressure should be added from the deviated side to make the shaft return to the correct position. However, since hydrostatic bearings usually contain [lots] a lot of [lubricat] lubricant, they are not suitable for small rotating machine parts that require high precision.--

The paragraph beginning on page 2, line 1, has been amended as follows:

--On the other hand, the hydrodynamic bearing is a bearing with tiny grooves located at the bearing's inner aperture. Within the grooves there is a lubricant (since the grooves [is] are tiny, the quantity of lubricant is quite limited). When the shaft rotates, the lubricant inside the grooves is drawn and builds up hydrodynamic pressure to support the shaft at [the centric] a centered position. However, since it is hydrodynamic, friction occurs when the shaft starts to rotate and pressure has not yet been built up. It is also very difficult to process the inner aperture inside the bearing, and difficult to control the processing precision (the [grooves] grooves' width is usually 100 μm , and the [grooves] grooves' depth [is] are even smaller). Moreover, there are problems with the lubricant seal and lubricant filling.--

The paragraph beginning on page 3, line 8, has been amended as follows:

--The manufacturing method of the hydrodynamic and hydrostatic hybrid bearing of the invention involves first forming a bushing, and then forming several dynamic pressure generating [groove] grooves on it. The bushing is integrated on the housing with the porous material inside, which contains lubricant. A shaft is installed within the bushing. The housing is pre-pressurized and sealed. Since the bushing is a kind of penetrated dynamic pressure generating groove processed independently, it is very easy to process. Also, because the porous material of the housing contains a lubricant, it is easy to fill and seal lubricant. Moreover, since the housing is pre-pressurized, it can store a suitable amount of lubricating media between the bushing and shaft. Therefore, starting friction can be avoided, and the bearing has both hydrodynamic and hydrostatic effects.--

The paragraph beginning on page 4, line 11, has been amended as follows:

--The hydrodynamic and hydrostatic hybrid bearing and its manufacturing method disclosed in the invention (shown in Fig 1) [contains] contain one shaft 10, one housing 20 and one bushing 30. The housing 20 is frame shaped, contains porous material 40 [inside], and can preserve the lubricant 50. One side of the housing is sealed with a sealing unit 70, so as to prevent the lubricant from being exposed. In the middle of the porous material 40 there is a space, which can be used to install the bushing 30. The bushing 30 [with] has a [cylinder] cylindrical shape and is used to install the shaft 10. The bushing 30 contains a plurality of penetrated dynamic pressure generating grooves 301 on its

surface. Lubricant 50 contained in the porous material 40 can ooze through these dynamic pressure generating grooves 301, to achieve the effects of lubrication and support.--

The paragraph beginning on page 4, line 21, has been amended as follows:

--In other words, the bushing 30 utilizes a processing method different from the previously discussed well-known inner aperture processing methods. It uses an independent processing means of penetration (see Fig 2), and then is installed in the housing 20 with porous material 40 inside. In this way, the surface of the inner aperture of the shaft 10 also contains dynamic pressure generating grooves 301. However, since the bushing 30 is processed independently, it makes processing easier. Also, processing methods can be more diverse. They are not restricted by the tiny size of the inner aperture, and the shape and precision of the dynamic pressure generating grooves 301 are not confined. As shown in Fig 2, the dynamic pressure generating grooves 301 are herringbone when it rotates opposite to the inner shaft 10. The lubricant on both sides of the dynamic pressure generating grooves 301 [are] is led to [concentrate] be concentrated in the middle and produces hydrodynamic pressure, which supports the shaft 10 in the middle of the bushing 30. [However, the] While a V-shape is [given] shown for example[;], the groove is not restricted to this shape. Any shape that can serve to build up hydrodynamic pressure while rotating is suitable. Furthermore, since the bushing is processed independently, the shape of the dynamic pressure generating groove 301 can be more diversified.--

The paragraph beginning on page 5, line 13, has been amended as follows:

--The porous material 40 inside the housing 30 contains a lubricant 50 (for example, lubricating lubricant). The porous material 40 should be pre-pressurized before sealing, and then sealed by a sealing unit 70 (for example, sealing glue and sealing cover, etc.) to prevent the lubricant from spilling out. Since pre-pressure 60 is added, the lubricant 50 flows out from the dynamic pressure generating [groove s301] grooves 301 of the bushing 30. It is kept between the bushing 30 and the shaft 10 (because of the equilibrium between sticky force and atmospheric pressure), as shown in Fig 3. As mentioned above, since the dynamic pressure generating grooves 301 are very tiny, just like a [capillarity] capillary, the lubricant can be kept between the bushing 30 and the shaft 10. Also, the amount of lubricant 50 can be adjusted to an optimum level by controlling the magnitude of pre-pressure. In a normal situation, when the shaft has not started moving, it will provide hydrostatic protection to avoid starting friction in the hydrodynamic bearing, and provide hydrodynamic and hydrostatic hybrid effects. On the other hand, since the bearing uses a lubricant 50 contained in the porous material 40, it is easy to fill and seal the lubricant. Moreover, the porous material 40 provides lubricating [lubricant] tank functions. When the lubricant 50 between the bushing 30 and the shaft 10 spills out, it presses the lubricant 50 out by pre-pressure 60, to re-supply the amount of lubricant 50 between the bushing 30 and the shaft 10.--

The paragraph beginning on page 6, line 4, has been amended as follows:

--As shown in Fig 4, in the manufacturing method of the hydrodynamic and hydrostatic hybrid bearing in the invention, the bushing is first formed (step 901). As shown in Figs. 5A and 5B, a cylinder-shaped bushing 30 with appropriate thickness t is formed,

and then several penetrated dynamic pressure generating [groove] grooves 301 are processed on the bushing. As mentioned above, there are many kinds of dynamic pressure generating grooves 301, and two groups of herringbone are shown in [this figure] Figs. 2 and 5C. A cutter process, etching or plastic injection can be used as a processing method. Since the dynamic pressure generating grooves are formed outside the bushing 30, the processing method is not restricted. Here only two methods are shown (see Fig. 5B). The burr is then eliminated to make it easy to install.--

IN THE CLAIMS:

The claims has been amended as follows:

1. (Amended) A hydrodynamic and hydrostatic hybrid bearing comprises:

a housing containing a lubricant;

a bushing placed in the housing having a plurality of dynamic pressure generating grooves being penetrated [to] through the bushing for storing the lubricant; and

a shaft rotatably installed in the bushing;

wherein the lubricant produces hydrodynamic pressure between the grooves and the shaft when the shaft rotates relative to the bushing.

2. (Amended) The hydrodynamic and hydrostatic hybrid bearing [as] of claim 1, wherein the housing comprises a porous material for storing a lubricant.

3. (Amended) The hydrodynamic and hydrostatic hybrid bearing [as] of claim 1, wherein [the housing is applied] a pre-pressure is applied to the housing for making the lubricant pass through the

grooves and [preserve] to be present between the bushing and the shaft.

4. (Amended) The hydrodynamic and hydrostatic hybrid bearing [as] of claim 3, wherein the housing further comprises a sealed unit to keep the pre-pressure.

5. (Amended) The hydrodynamic and hydrostatic hybrid bearing [as] of claim 4, wherein the sealed unit is a sealed glue.

6. (Amended) The hydrodynamic and hydrostatic hybrid bearing [as] of claim 1, wherein the bushing is a cylinder-shaped bushing.

7. (Amended) The hydrodynamic and hydrostatic hybrid bearing [as] of claim 1, wherein the dynamic pressure generating grooves [is] are two pair of herringbone grooves.